APPLICATION OF THE LONGSHORE TRANSPORT CURVE FOR COASTAL STRUCTURE IMPROVEMENTS AT COQUINA BEACH IN MANATEE COUNTY, FLORIDA

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FSBPA Technical Conference
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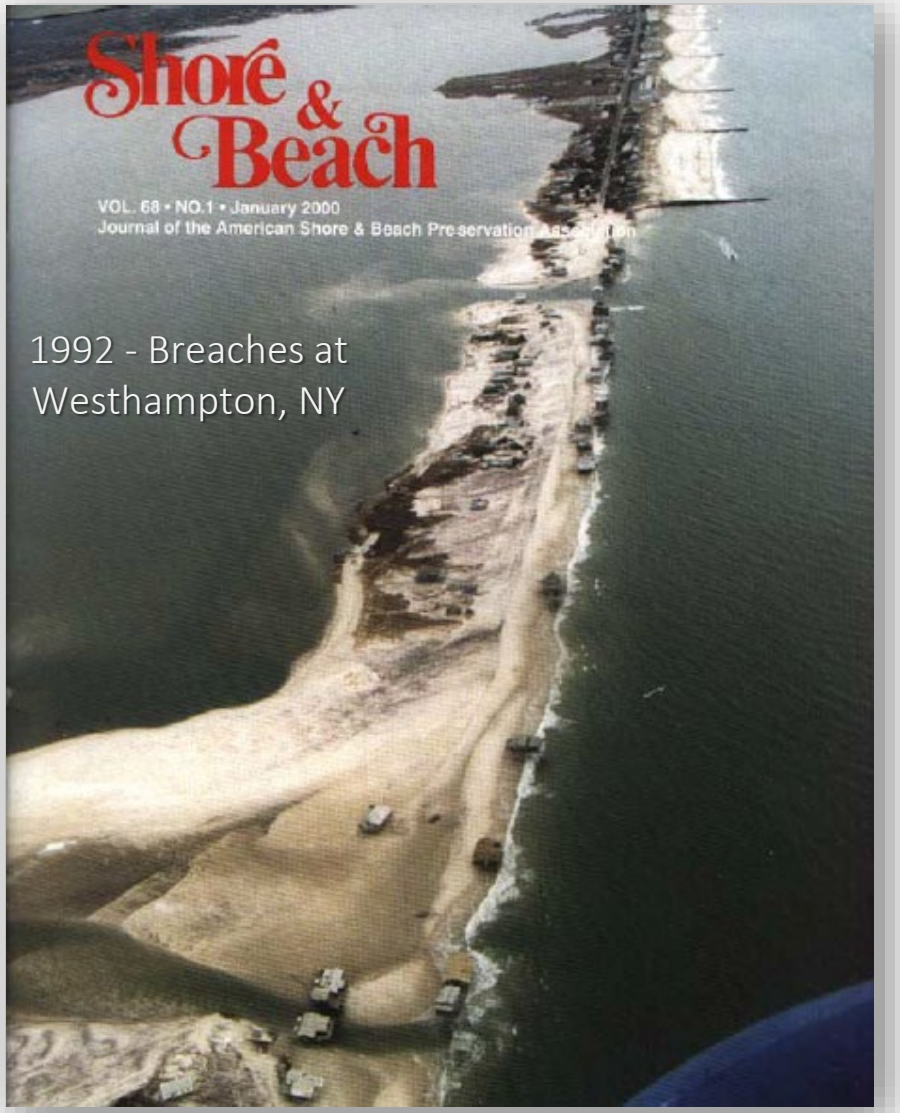
Fort Myers, FL

COASTAL STRUCTURES



- Highly effective for beach stabilization
- Poor reputation for being overused and misunderstood

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STRATEGIC USE OF COASTAL STRUCTURES

PART 1 -

- *Examples And Design Guidance*
- FSBPA Tech Conference Stuart, FL
- February 2014

PART 2 -

- *Recent Applications and Advancements*
- FSBPA Tech Conference in Sand Key, FL
- February 2015

Main Topics:

- Reintroducing structures for erosion control
- Seawalls, revetments, bulkheads, groins, breakwaters
- Advancements in permeability and adjustability
- **Application of Longshore (Littoral) Transport Curve**

National Conference on Beach Preservation Technology

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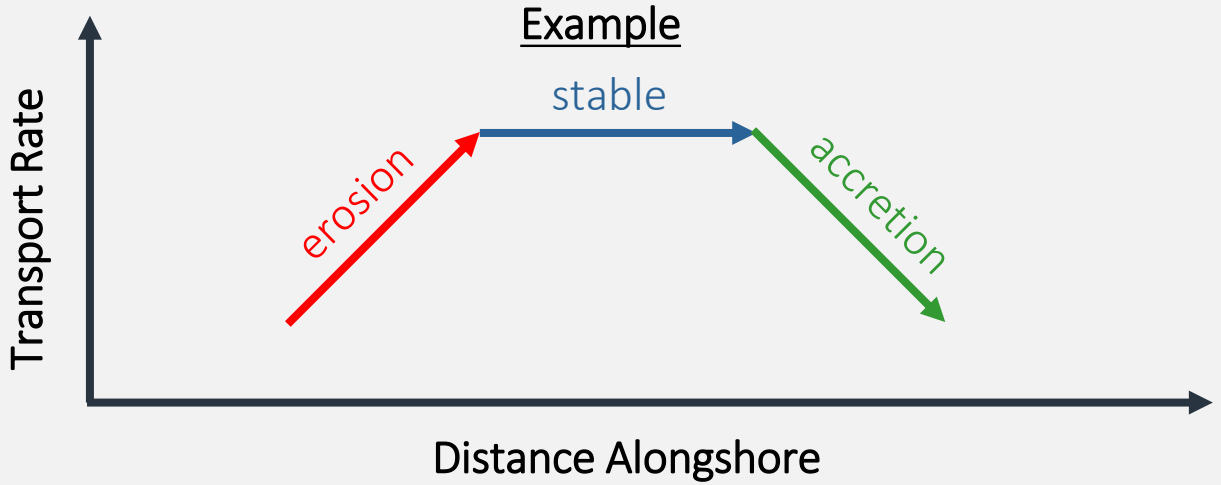
LONGSHORE TRANSPORT (LST) CURVE

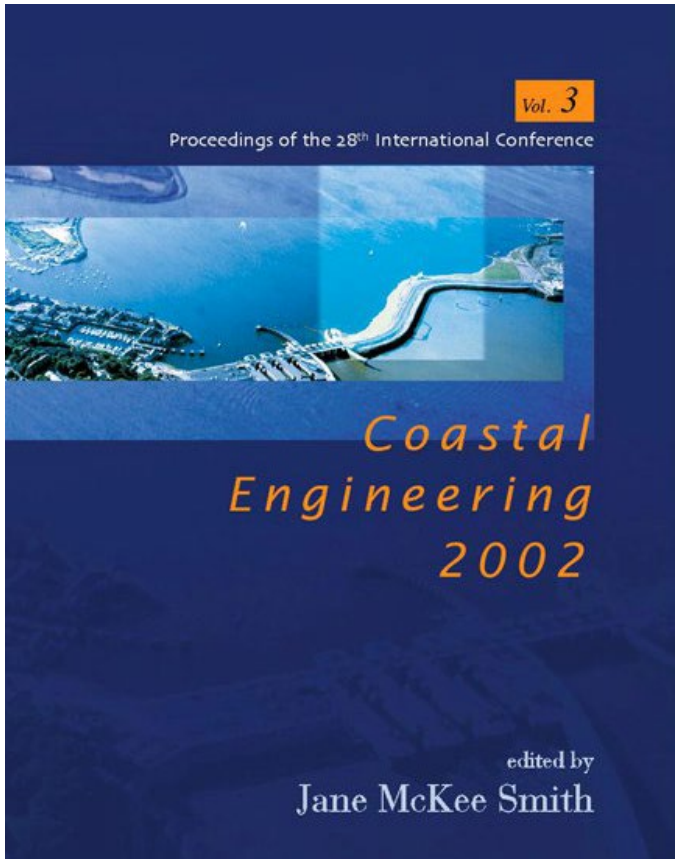
- Used to track sediment migration through an area of study
- Based on measured volume changes, annualized and summed alongshore
- Adjusted for inlet bypassing and beach nourishment projects

- Shape of the curve:
  - Increasing slopes are erosion
  - Decreasing slopes are accretion
  - Flat slopes are stable (or hardened)

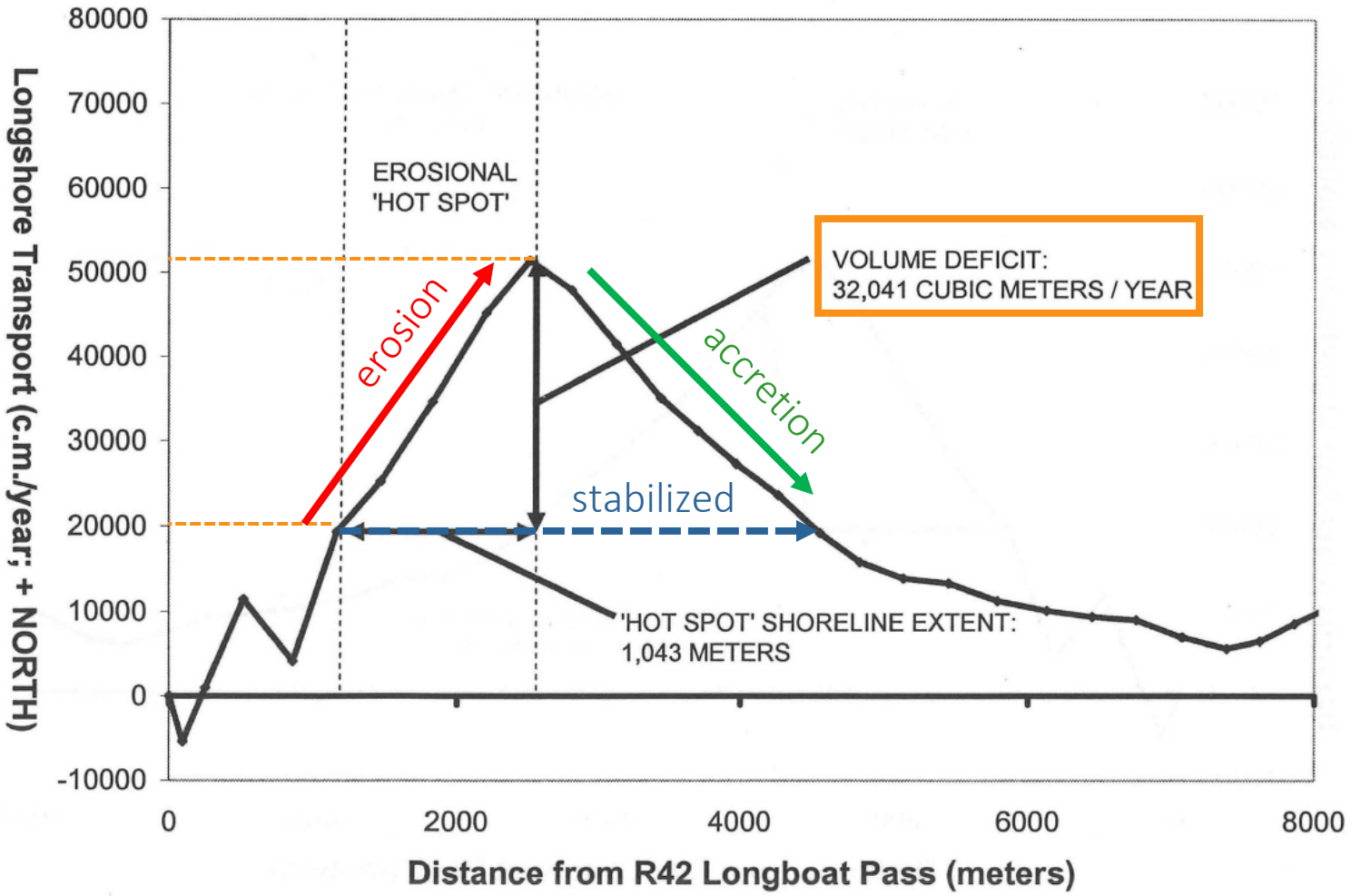


- Valuable tool for design of coastal structures

CAMPBELL & JENKINS, 2002



Proceedings of the 28th International Conference on Coastal Engineering



Campbell T.J. and Jenkins, M.G., 2002. Design considerations for hot spot erosion areas on beach nourishment projects. Proceedings of the 28th International Conference on Coastal Engineering, Vol 3, pp. 3642-3648.

RELEVANT CONCLUDING REMARKS (FROM PREVIOUS PRESENTATIONS)

National Conference on Beach Preservation Technology

- Coastal structures have a place in contemporary beach nourishment projects.
- To be used with care, based on experience, engineering analysis and site-specific needs.
- Structure field should extend to accretional area to balance longshore transport curve.
- Cost savings due to hotspot control can offset the cost of installing structures.
- Structures are highly effective but there is no “one-size fits all” application.
- Large erosion areas may require more extensive structural intervention.

Numerical models provide opportunity to compare alternatives and refine designs quantitatively and qualitatively …

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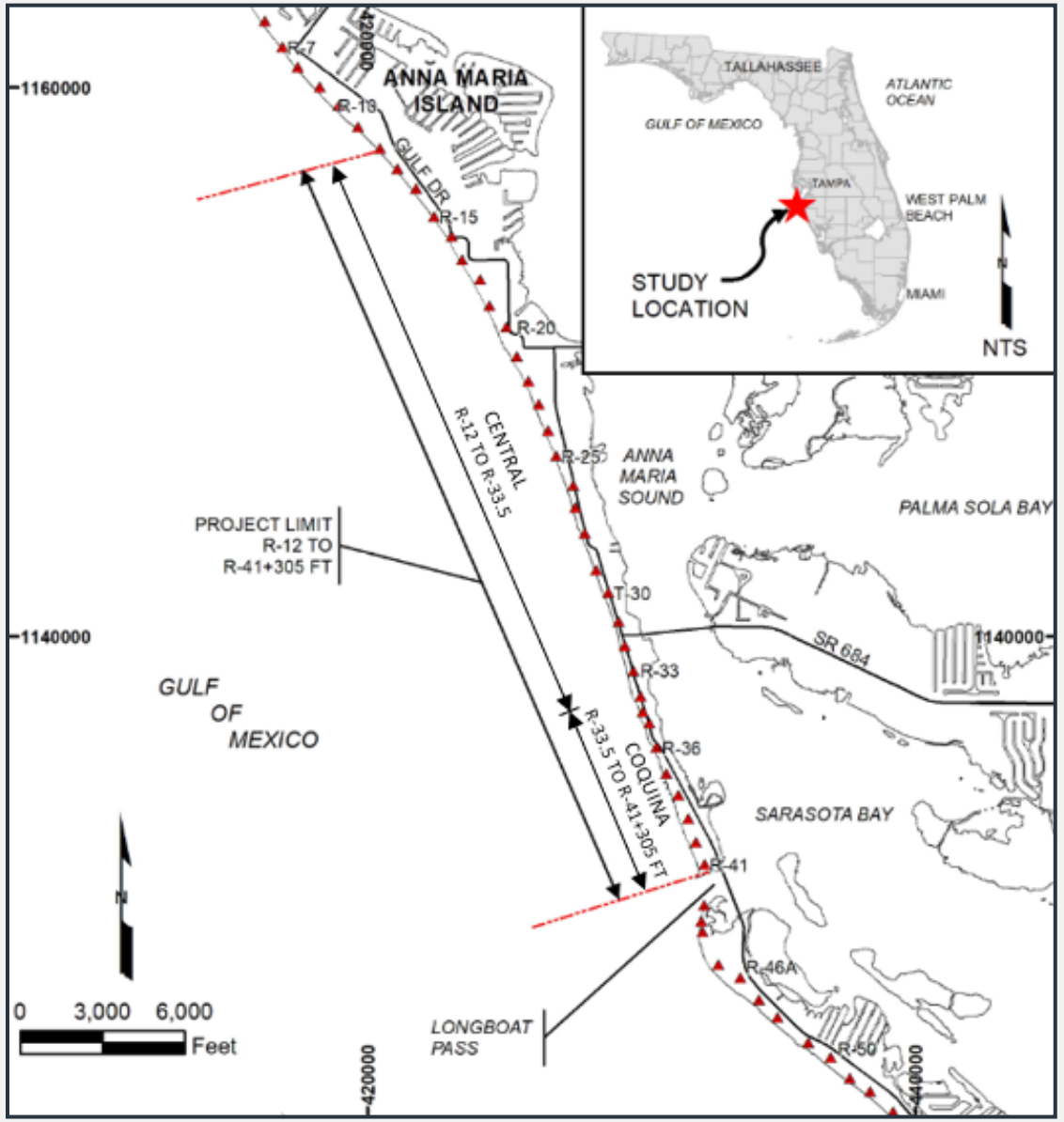
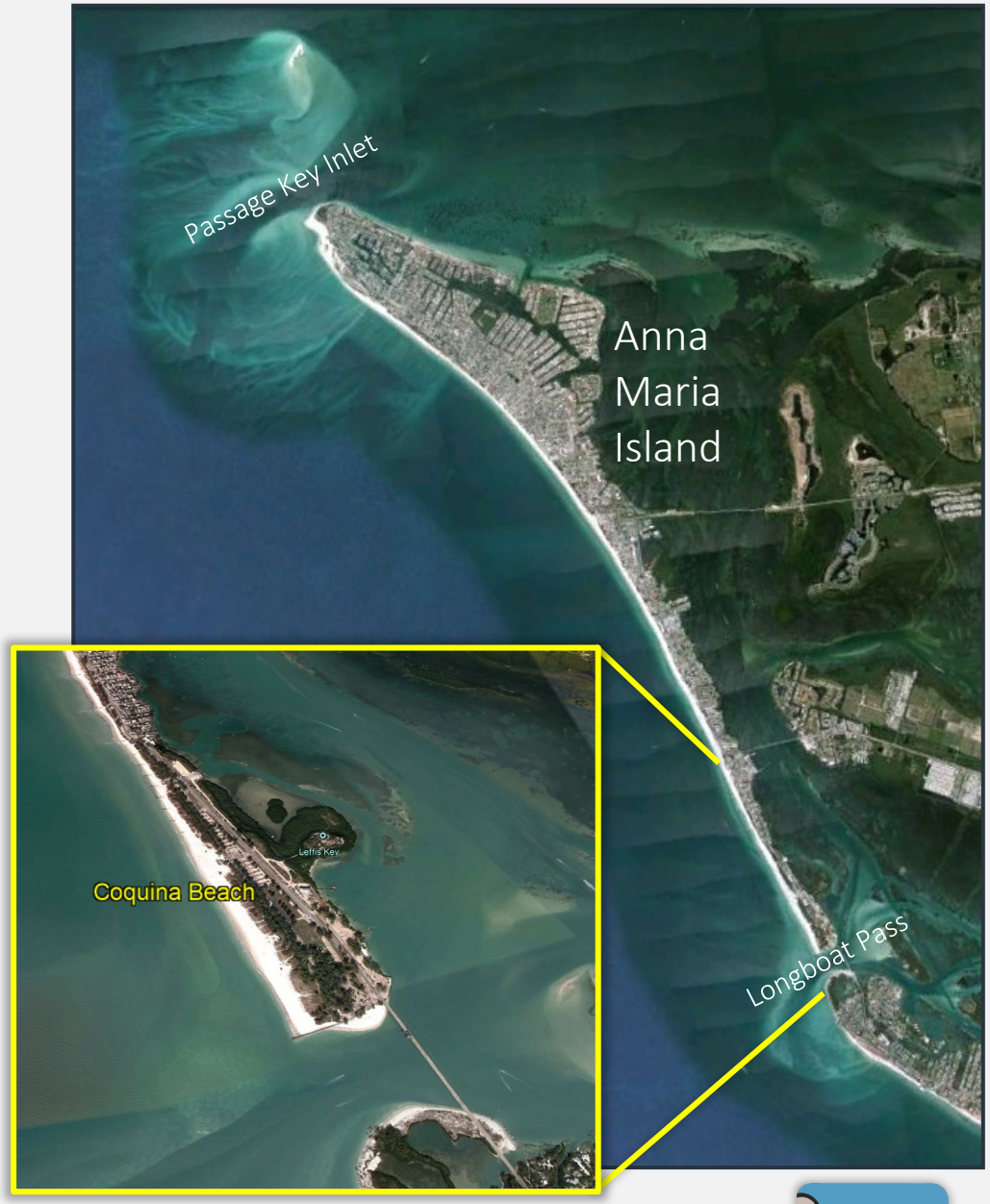
ANNA MARIA ISLAND

- Manatee County, Florida
- 7-mile-long barrier island
- Passage Key Inlet to north and Longboat Pass to the south
- Coquina Beach:
  - Southern mile of island
  - Public beach and recreation facility
  - Aging shore-perpendicular groins throughout of the project area
  - Stabilized by terminal groin known locally as the Longboat Pass Jetty



BEACH NOURISHMENT

- Primary means of erosion control:
  - 6.8 million cubic yards of sand since 1992
  - Supported by coastal structures in Bradenton Beach and Coquina Beach



COQUINA BEACH HISTORY

- Only accessible by boat until 1921
- Man-made extension of Anna Maria Island
- Stabilized by groins to protect road in 1959
- Top 10 Island Beaches for Perfect Sand

Image Source: https://www.worthpoint.com/worthopedia/1959-aerial-anna-maria-island-manatee-401907321

Condé Nast Traveler

"It's laid-back, bordered by towering pines, and boasts perfect, unspoiled sand as fine as powder." – CNT (2015)

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LONGBOAT PASS
MANATEE COUNTY

Inlet influences coastal processes

Sand moves into flood shoal

Tidal Flow

Wave Action

Bypassed sand can move two ways

Wave Action

Sand moves into ebb shoal

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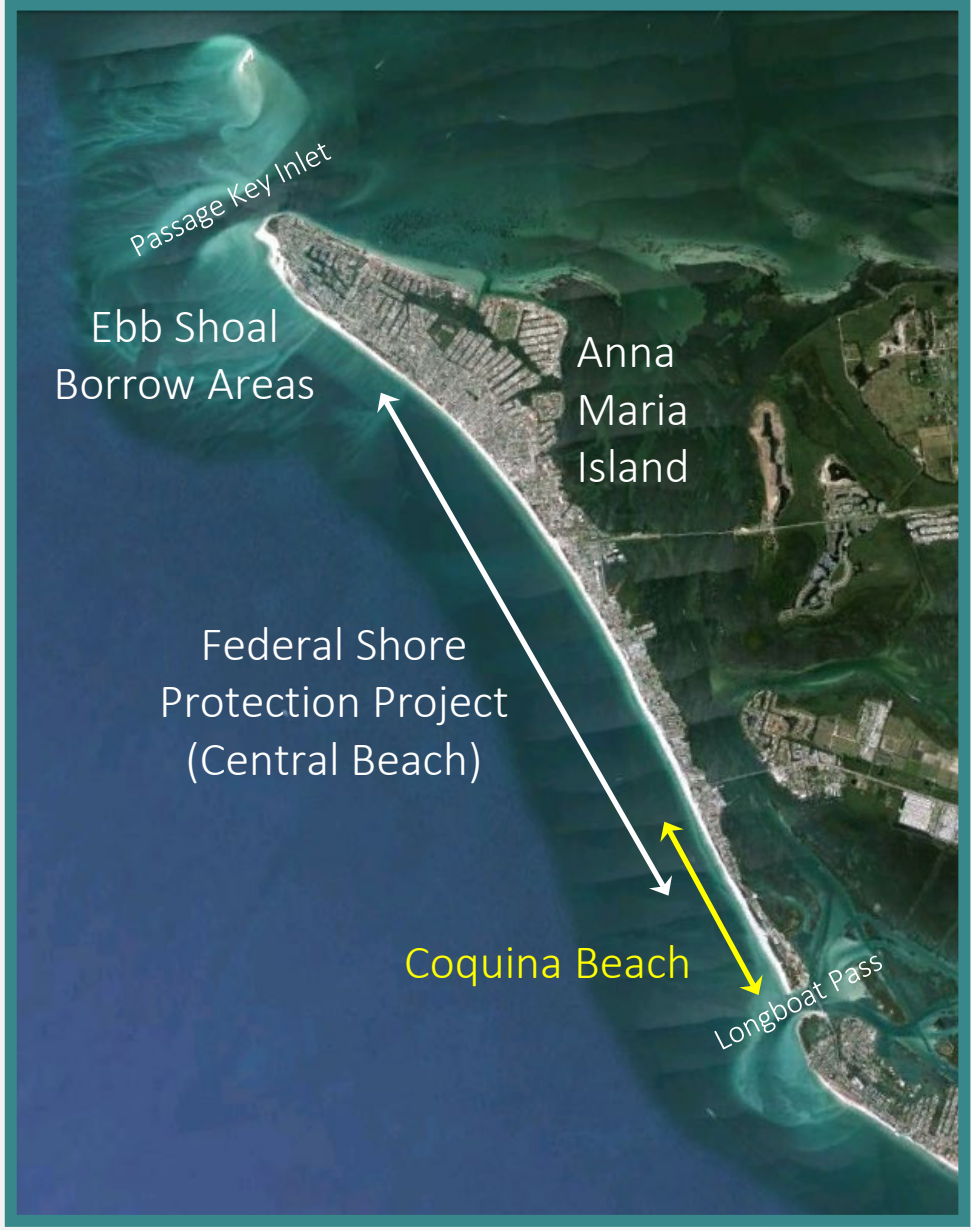
COQUINA BEACH PROJECT

- Locally managed by Manatee County
- 1.5 miles from 4th St. S to Longboat Pass
- Initial restoration in 2011
- Renourished in 2013-2014 and 2020
- FEMA repair project completed 2021
- Stabilized by groins and terminal groin (Longboat Pass Jetty)



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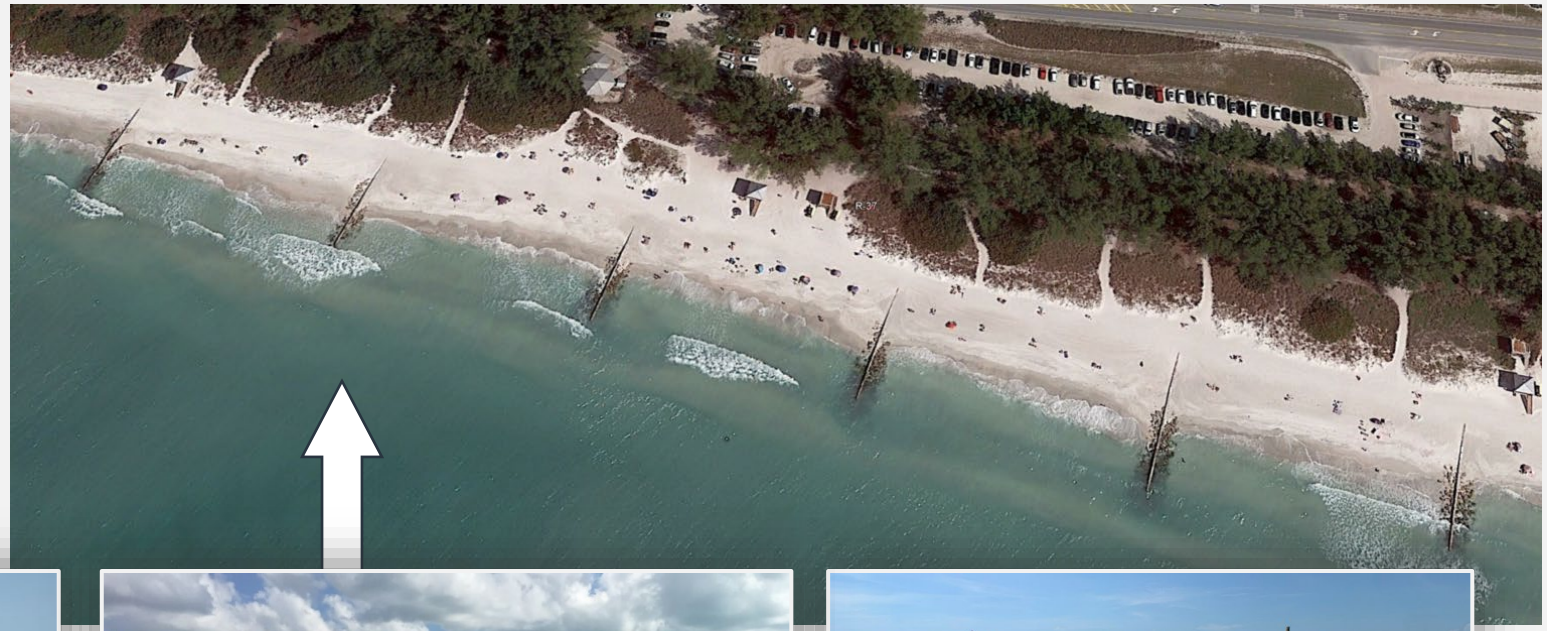
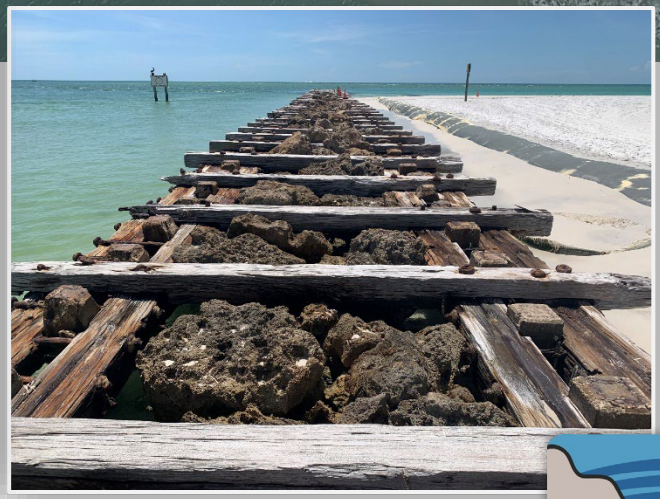
EXISTING COASTAL STRUCTURES

- Cortez (PAG) Groins
- Coquina Beach Groins
- Longboat Pass Jetty
- Geotextile Tubes





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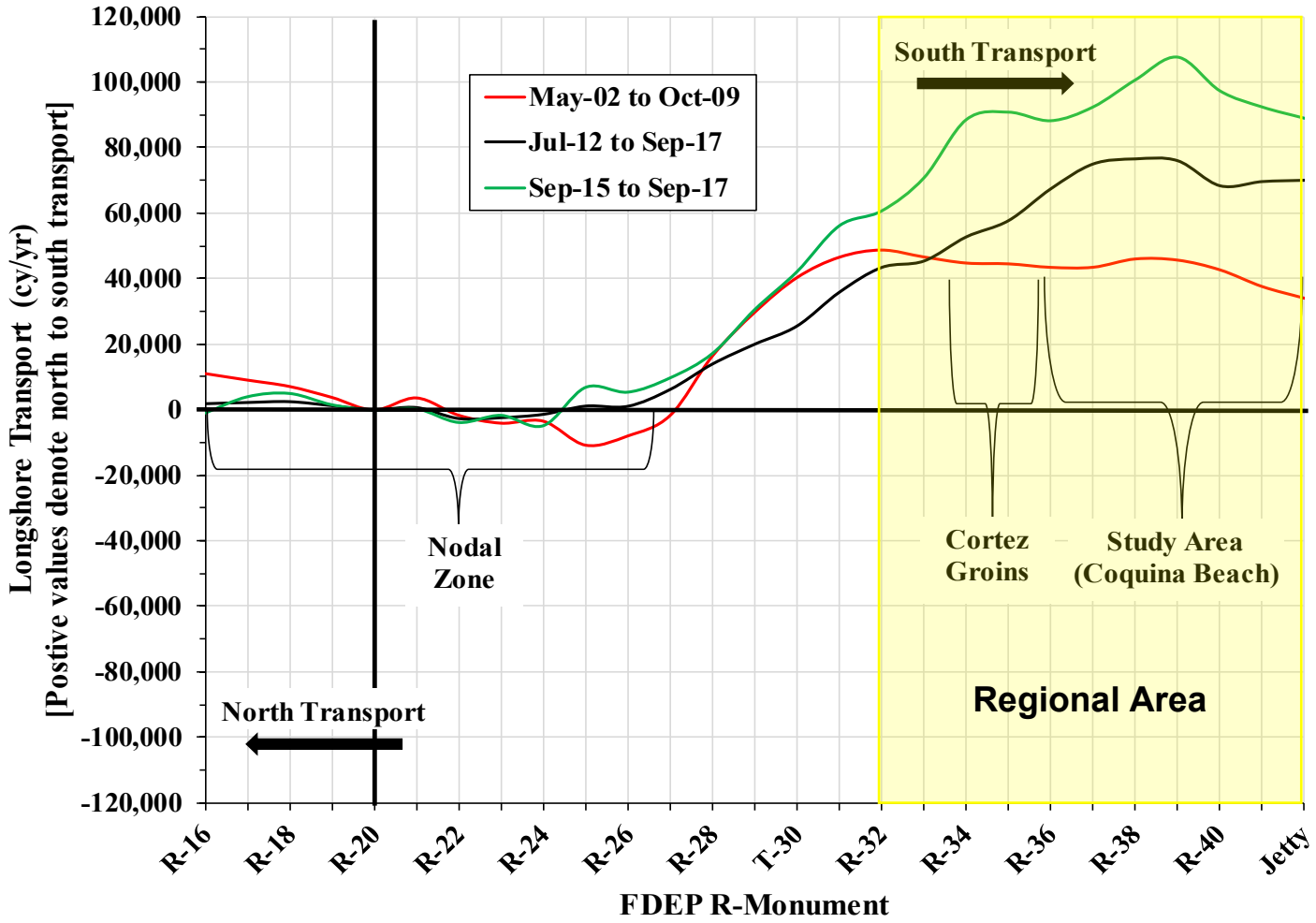
COASTAL PROCESS ASSESSMENTS



- Shoreline changes
- Volume changes
- Even odd analysis
- Sediment budget
- Longshore transport:
  - 2012 – 2017
  - 2015 – 2017
- Regional area:
  - +30,000 cy/yr
  - Net erosion

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ALTERNATIVES ANALYSIS

Structural Stabilization of Coquina Beach

Longboat Pass Jetty Rehabilitation

	Conceptual Alternatives
1	Existing Conditions (No Action)
2	Removal of Existing Coquina Beach Groins
3	Restoration of Existing Coquina Beach Groins
4	Removal of Existing Groin Field and Replacement with 8 PAGs
5	Removal of Existing Groin Field and Replacement with 4 PAGs
6	Removal of Existing Groin Field and Replacement with 8 Breakwaters
7	Removal of Existing Groin Field and Replacement with 3 Breakwaters
8	Alternative 7 + Longboat Jetty Removal
9	Alternative 7 + Longboat Jetty Extension of 100 feet
10	Alternative 7 + Longboat Jetty Deterioration

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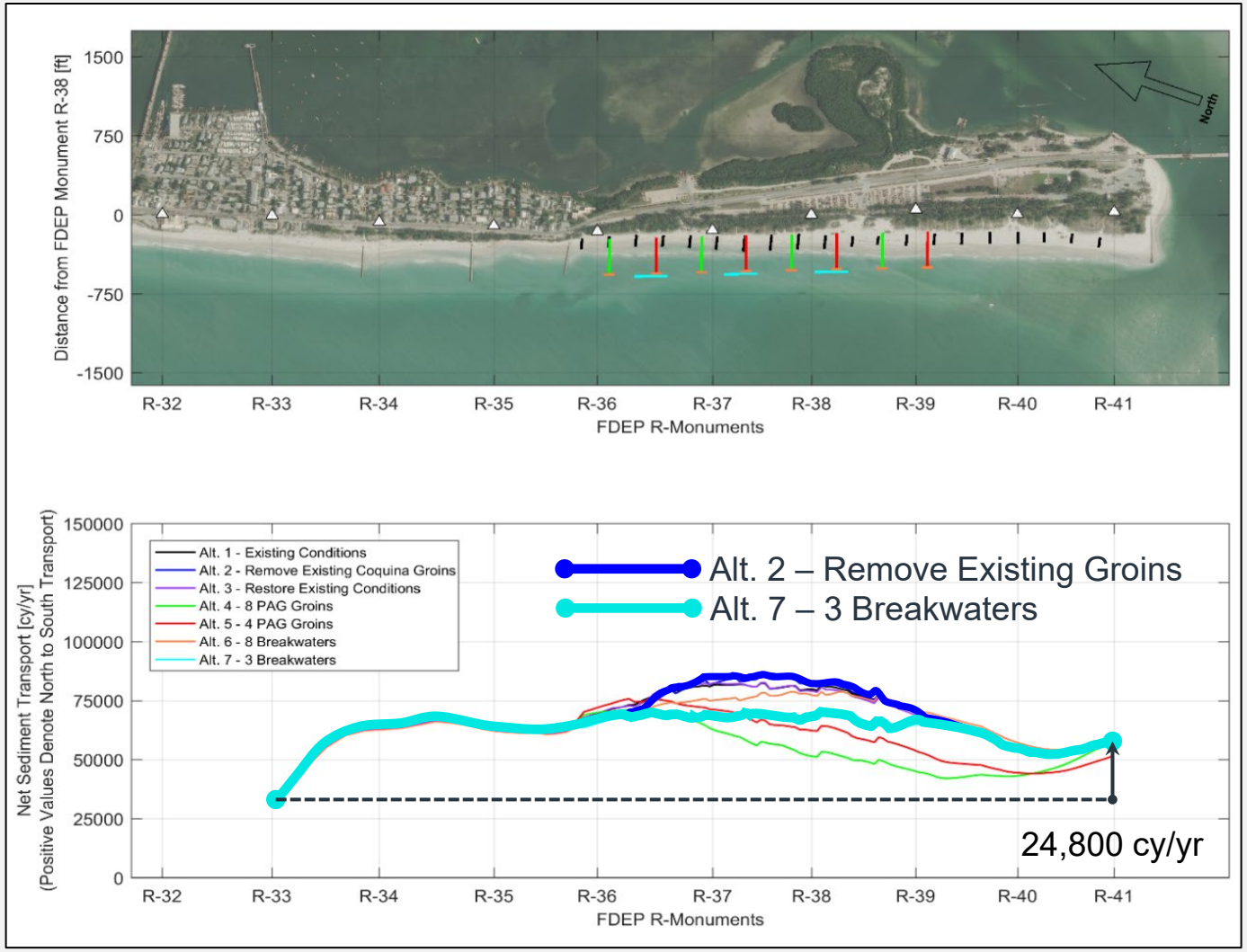
APPLICATION OF LST CURVE (1-YEAR SIMULATION)

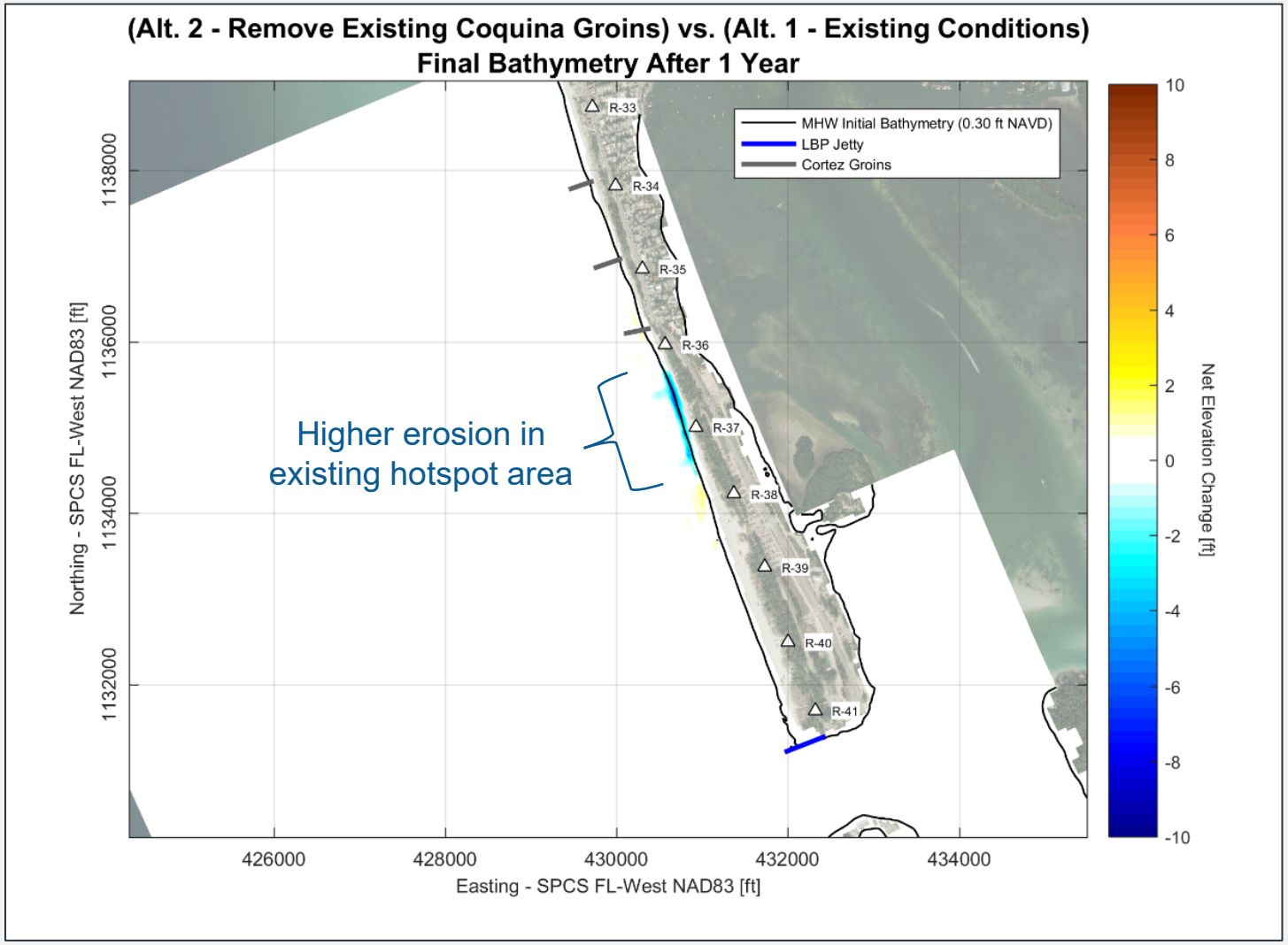


- Southerly directed transport
- 24,800 cy/yr (existing)

- Objectives:
  - Preserve regional transport
  - Balance erosion trend
  - Extend life of beach fill

- Stabilize beach in north
- Extend into accretion area
- Overlap inlet fillet

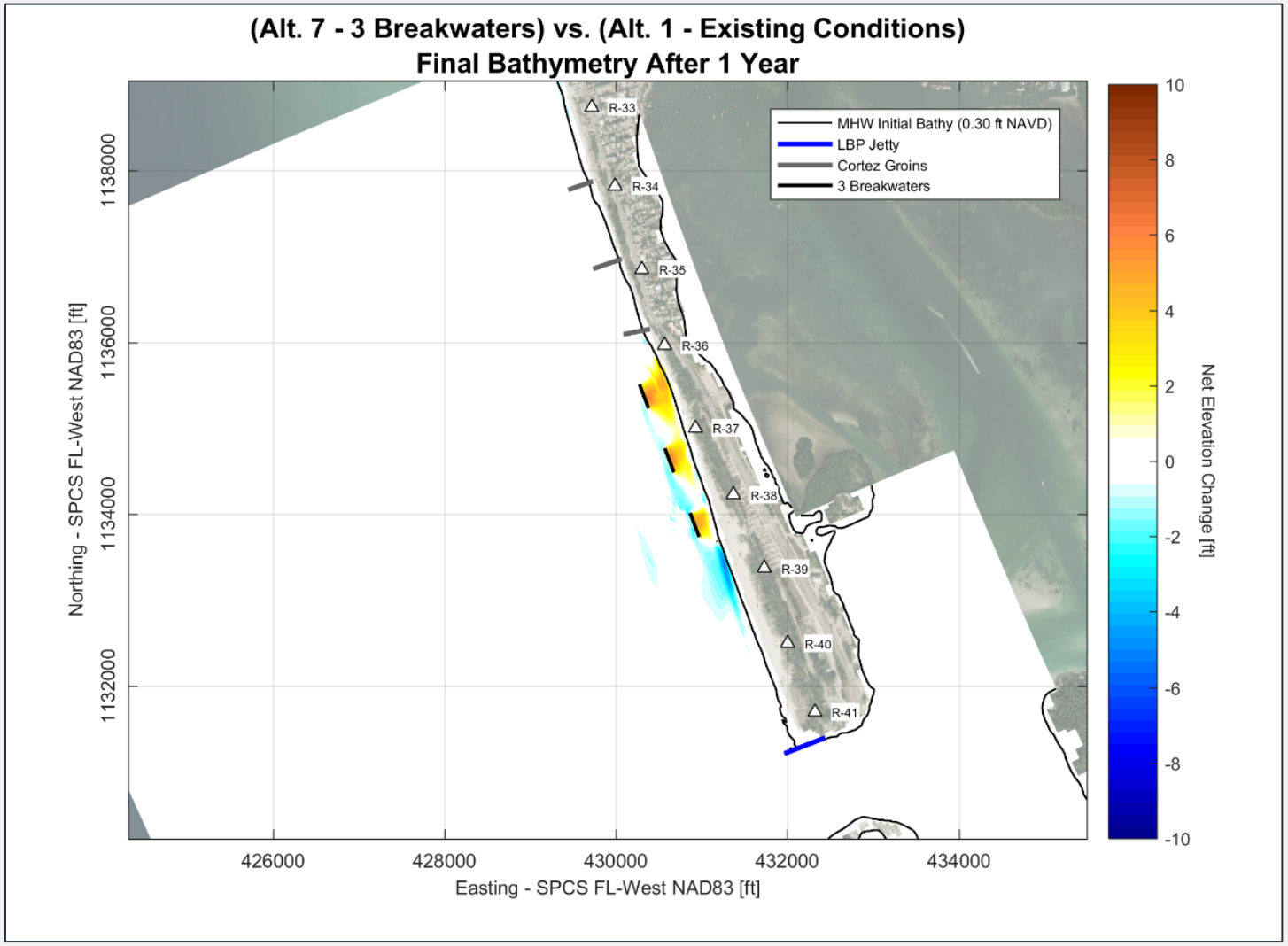
STRUCTURE REMOVAL (ALT 2 – 1 YEAR)



- 1-year model simulation

	Alternative	Net sediment transport between monuments R-33 and R-41 [cy/year]	Net sediment transport difference between Alternative 1 and Alternative [cy/year]
1	Existing Conditions (No Action)	24,800	NA
2	Removal of Existing Coquina Beach Groins	24,700	-100
3	Restoration of Existing Coquina Beach Groins	24,500	-300
4	Removal of Existing Groin Field and Replacement with 8 PAGs	25,800	1,000
5	Removal of Existing Groin Field and Replacement with 4 PAGs	19,500	-5,300
6	Removal of Existing Groin Field and Replacement with 8 Breakwaters	25,700	900
7	Removal of Existing Groin Field and Replacement with 3 Breakwaters	24,800	0

RECOMMENDED ALTERNATIVE (ALT 7 – 1 YEAR)



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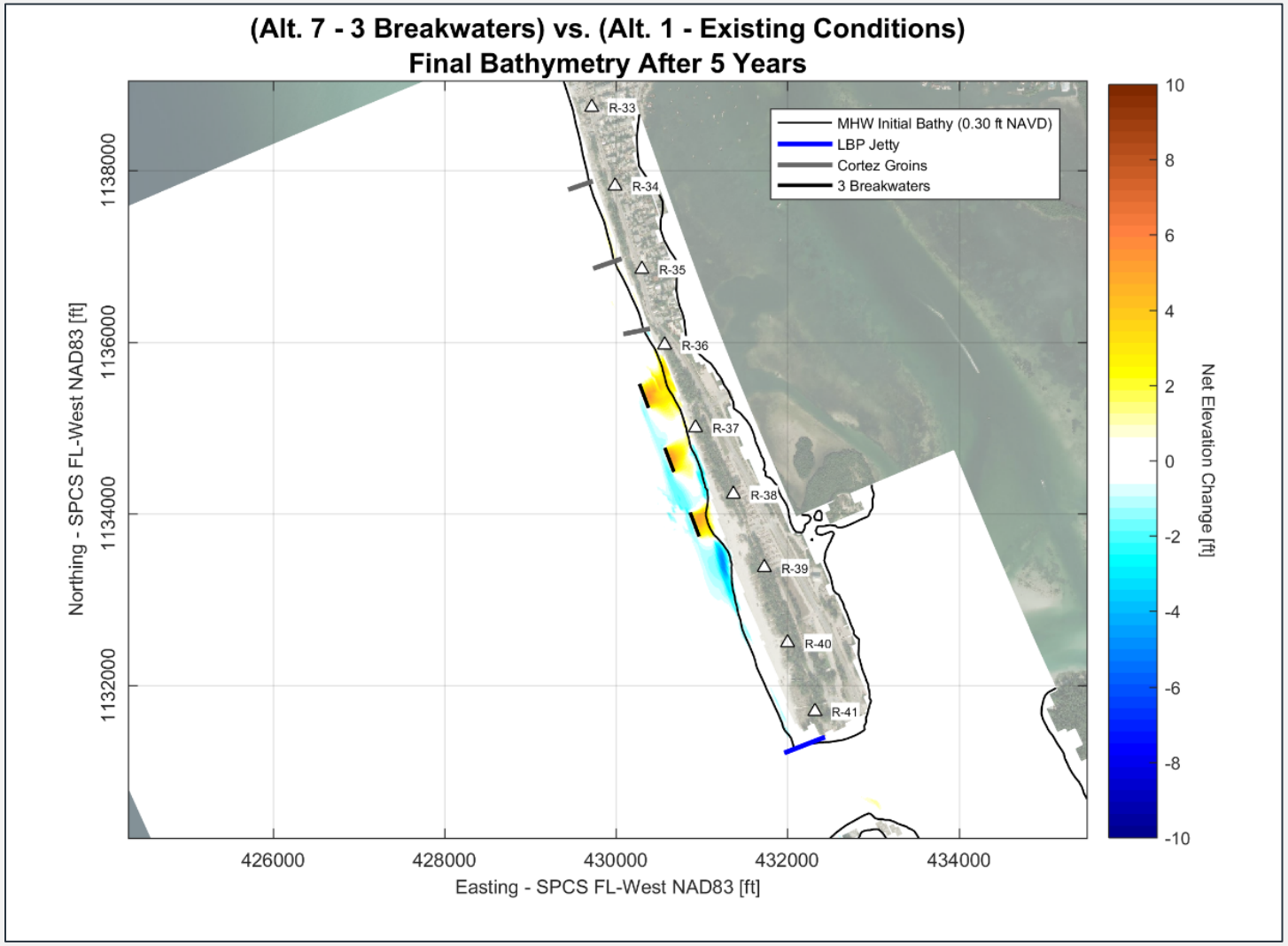
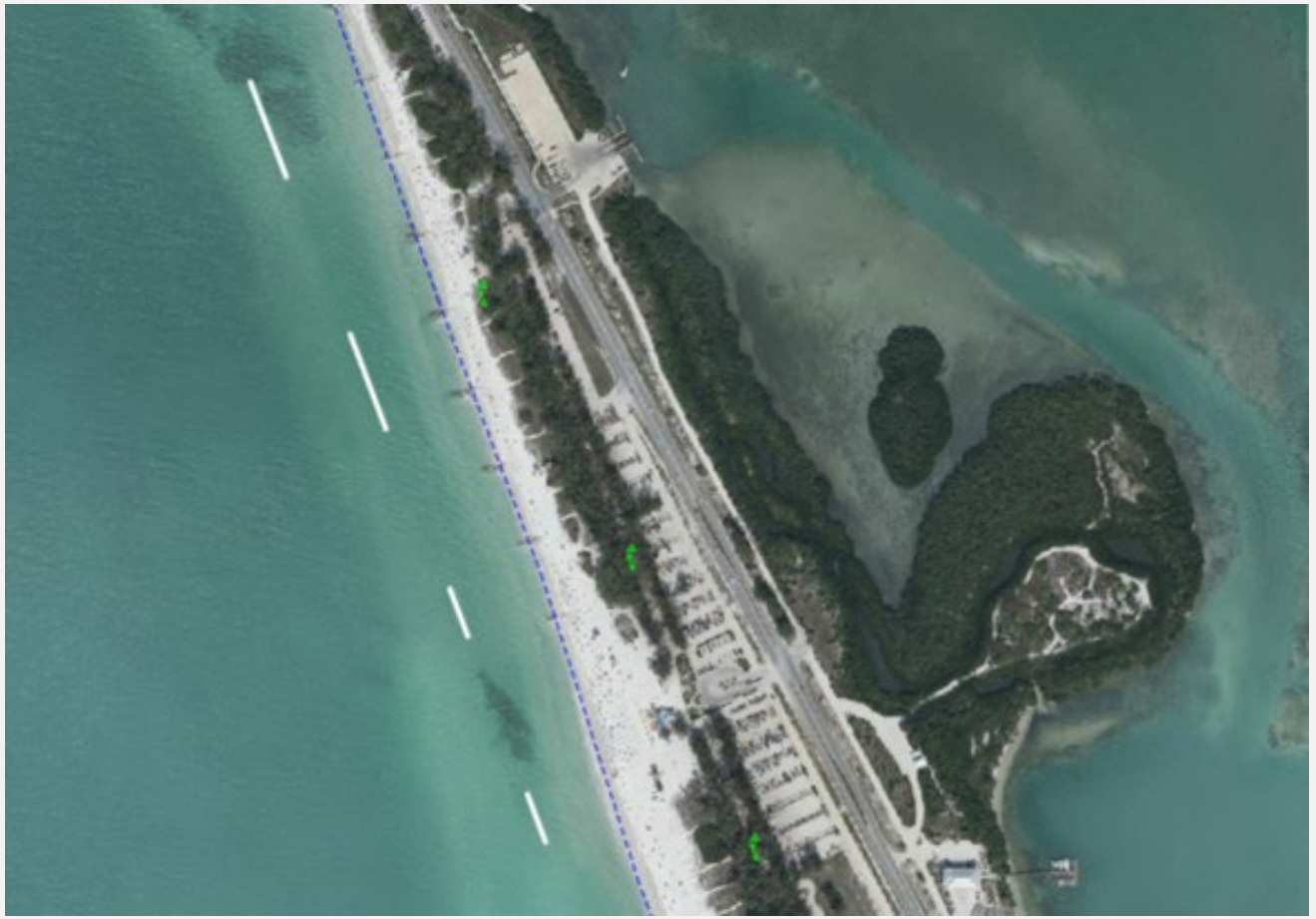
RECOMMENDED ALTERNATIVE (ALT 7 – 5 YEAR)



- Balances erosion overall
- Provides uninterrupted alongshore view
- Removes damaged groins
- Installs new breakwaters:
  - +4 feet NAVD
  - 300 ft length
  - 500 ft spacing
  - 300 ft offshore (varies)
- Refinements ongoing

BREAKWATER DESIGN REFINEMENTS

Split Southern Breakwater



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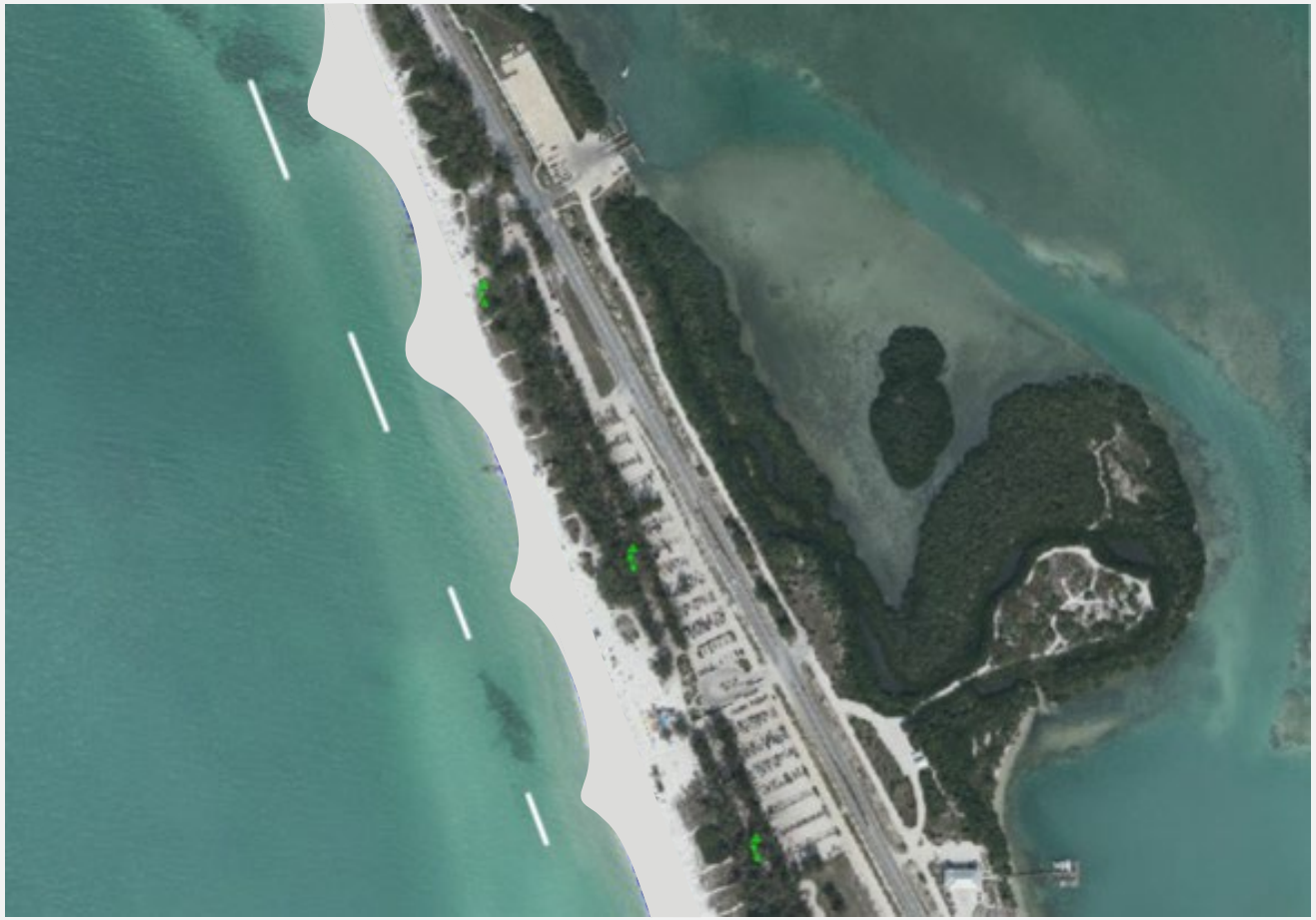
BREAKWATER DESIGN REFINEMENTS

Parabolic Shoreline Model (Silvester & Hsu, 1993)

MepBay Application: Hsu, J.R.C.; Benedet, L.; Klein, A.H.F.; Raabe, A.L.A.; Tsai, C.P., and T.W. Hsu, 2008. Appreciation of static bay beach concept for coastal management and protection. Journal of Coastal Research, 24(1), 198–215. West Palm Beach (Florida), ISSN 0749-0208.

BREAKWATER DESIGN REFINEMENTS

"Engineer's Rendering"



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OVERALL FINDINGS

- Structural stabilization continues to be needed in Coquina Beach
- LST curve is a key tool for design to preserve sediment transport
- Recommended actions:
  - Remove northern groins
  - Replace with breakwaters
  - Retain southern groins
  - Restore Longboat Pass Jetty
  - Continue beach nourishment
- Refine placement for fine tuning

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THANK YOU!

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Manatee County FLORIDA

Florida Department of Environmental Protection

APTIM

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